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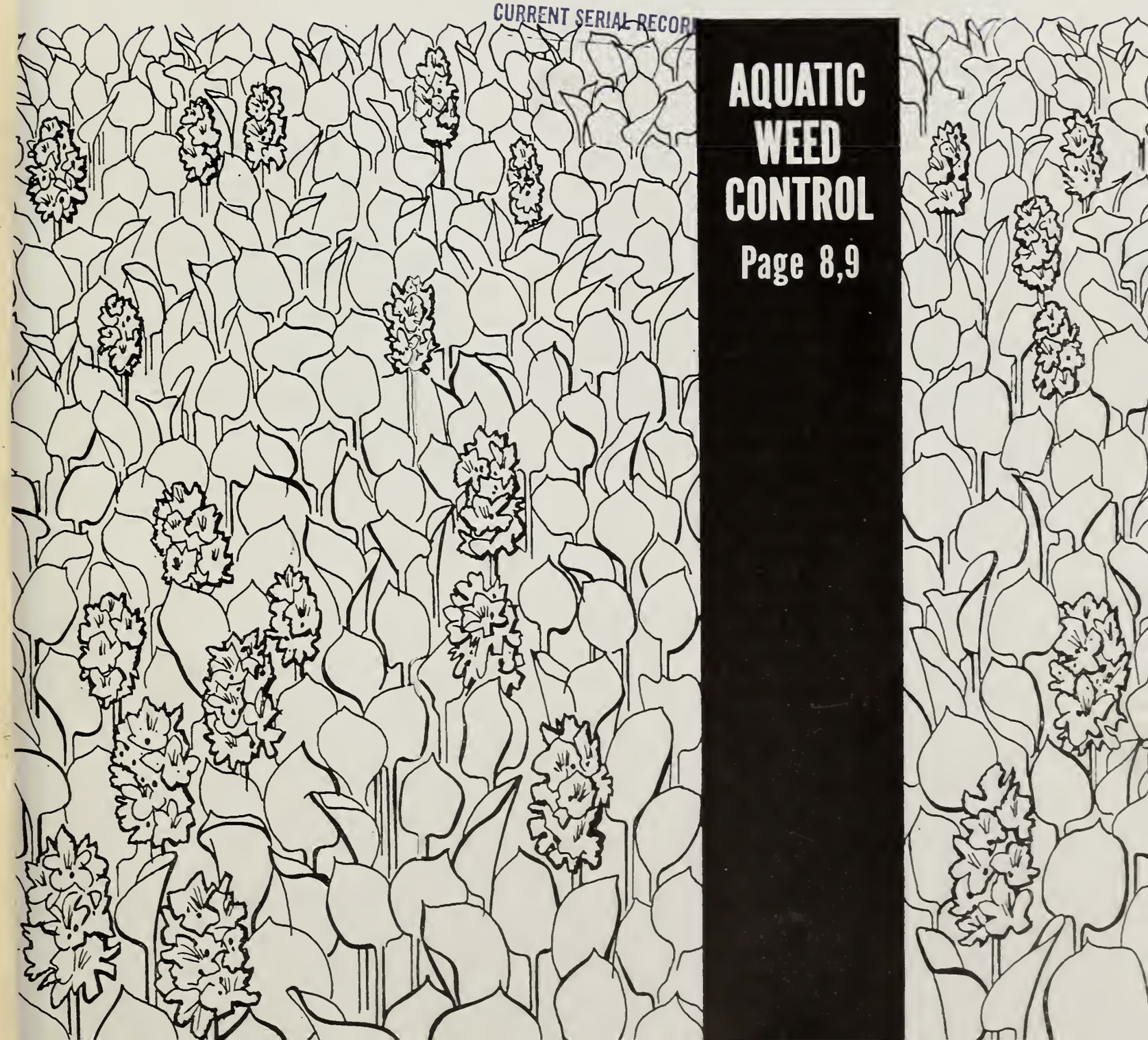

AQUATIC WEED CONTROL

Page 8,9

AGRICULTURAL
Research

October 1967/Vol. 16, No. 4

Weed-Free Waterways

Weed-free Southeastern waterways are coming closer to becoming a reality.

In the Southeast, water hyacinth and alligatorweed clog waterways, interfere with transportation, irrigation, hydroelectric power production, and recreation. They also endanger public health by creating mosquito breeding places.

Besides clogging waterways, these aquatic weeds cause great water loss through evapotranspiration. More water is lost than is taken in through rainfall and surface runoff. This problem is present in other parts of the world with climates similar to that in the Southeastern area of the United States.

For years ARS scientists have sought ways to control aquatic weeds. They have experimented with South American insects with an appetite for water hyacinth and alligatorweed (AGR. RES. February 1967, p. 10; AGR. RES. April 1962, p. 8). Various herbicides have been tested (AGR. RES. February 1967, p. 8). Working on their own, local waterway users have tried boats with weed-chopping devices attached in an attempt to control these pests. No approach has been entirely successful.

Now, by simply casting the herbicide, 2,4-D on weed-choked waters, ARS scientists have met with great success in killing water hyacinth (pp. 8, 9). Scientists have developed the "floating granule" technique, using perlite, a light volcanic glass, as a vehicle to float the herbicide paraquat on the water's surface, killing alligatorweed and duckweed. They believe the method will prove effective in fighting other floating weeds.

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Orville L. Freeman, Secretary
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G. W. Irving, Jr., Administrator
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new lures to trap JAPANESE BEETLES

THE ABILITY OF Japanese beetles to detect odors may lead to their doom on Nantucket Island off the Massachusetts coast.

Odor is one way the beetles find roses, corn, and many other plants they infest. Scientists are exploiting this by developing powerful lures that are more attractive than the beetles' natural food.

ARS entomologist D. W. Hamilton placed experimental lures in some 2,000 traps scattered across Nantucket—a rate of about 1 trap per acre. More than 27,000 beetles responded and died in the traps during the 2 years of testing, and although results are preliminary, the traps offer promise of new nonchemical control aid.

Traps are now used to detect infestations of many kinds of insects before serious damage occurs, but with enough traps and a strong enough lure, the technique could control pests as well as provide a survey tool.

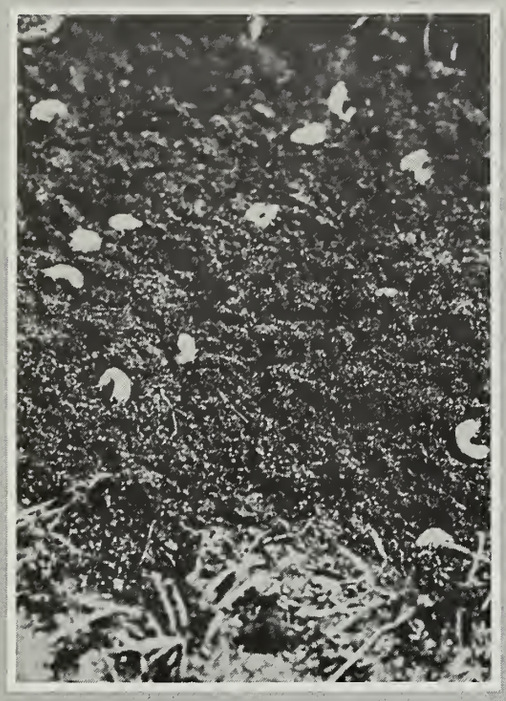
Mass trapping is in its third year of testing on Nantucket. The island was chosen because of its distance—30 miles—from the mainland, giving it sufficient isolation to prevent mainland beetles from flying in and interfering with evaluation of the effectiveness of mass trapping on a known beetle population.

Japanese beetles crawl down funnel-shaped portion of trap to reach lure; then fall into cylinder (PN–1550).

Mass trapping uses only small amounts of chemical lure—and pesticides, if used. This reduces both residue risks and control costs. They are limited to the traps.

Early in the tests, the traps attracted almost as many bumblebees as beetles. However, Hamilton found that this posed little threat to the bees or to crop pollination. A survey at the end of the first season's tests showed that the bumblebees were still abundant. A local cranberry grower reported no effects of the traps on his honey bee colonies.

The next year, Hamilton modified most of the traps to reduce their attractiveness to bumblebees. Since the bees were attracted to white or yellow traps used earlier, half of the traps were painted green. Trap colors had



Japanese beetle grubs in Nantucket; adults emerge in July (J–266–B).

little effect on beetle captures.

Scientists also tested additional lures. Anethol-eugenol, used the first year, attracted bumblebees. But the most promising of 19 lures tested later—phenyl ethyl butyrate-eugenol—was twice as attractive to Japanese beetles as the anethol-eugenol and, happily, least attractive to the bees.

Good timing also reduced bee trapping. Hamilton found, when he changed the start of trapping from mid-June to early July. This didn't seriously impede beetle trapping because, in the Nantucket climate, most of the adult beetles didn't begin to emerge from the soil until July.

Another finding that brings mass trapping closer to practical application is that lures tested so far can be stretched twice as far by diluting them 50 percent with deodorized kerosene. This reduces the cost of the lures without reducing trapping effectiveness.

Nantucket officials and residents are cooperating with ARS. More tests are being planned to confirm earlier findings and to obtain additional information on mass trapping methods.■

Japanese beetles feed on a grapevine. The foliage of all varieties of grapes is preferred food for the beetle and is frequently skeletonized (J–3443).

BACTERIA—CLOAKED in tiny little time pills—may rid infested alfalfa, corn, and cotton fields of insect pests.

Entomologists E. S. Raun and R. D. Jackson of the ARS laboratory, Ankeny, Iowa, are using small capsules similar to those used by humans for all-day cold relief. Over a selected number of days, the capsules uniformly release bacteria that is fatal to insects in infested cornfields.

The bacteria, *Bacillus thuringiensis*, is not harmful to man, animals, or crops, but attacks corn borers and some other destructive insects. If successful, the method would be inexpensive and easily adaptable to commercial corn growing.

Tests by Raun and Jackson show that the capsule insecticides are as practical as conventional sprays or dusts. The bacterial capsules were as effective as DDT treatments used in comparison tests on corn plots. About 90 percent of the borers died within 3 days after the capsules were distributed.

The Iowa Agricultural Experiment Station is cooperating in the research.

The capsule withholds its lethal contents until it gets wet, allowing the living insecticide to seep through. In the laboratory, the most promising capsule material tested began to release the bacteria about 10 minutes after it got wet.

In the field, capsules would be spread with a commercial granule dispenser, scattering them so that some fall in the curl and some in the leaf sheath where it joins the stalk. These areas usually hold small reservoirs of water that would activate the capsules. And, just as important, these are also the areas where borers are often found. This is about as close as a farmer can come to hitting the bullseye with an insecticide without spraying the entire plant.

Raun and Jackson got best results with a capsuled spore mixed in a powder to provide an application rate of 4 pounds of material that spread several billion bacterial spores per acre. Different spore concentrations can be formulated according to the severity of infestations. Spores can also be suspended in a liquid in the capsules.

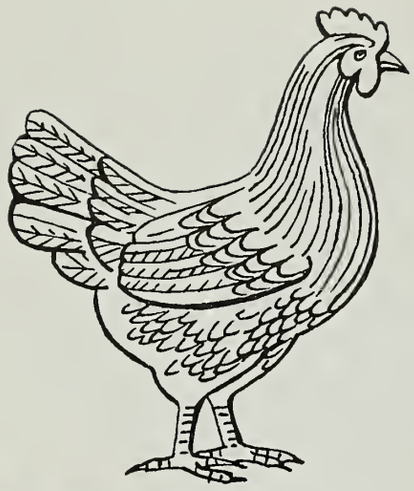
With promising results demonstrated against corn borers, entomologist P. Luginbill, Jr., has launched another phase of the capsule tests, under contract with a commercial firm. The contractor will furnish Luginbill with encapsulated insecticides and viruses for testing against both foliage and soil insects.

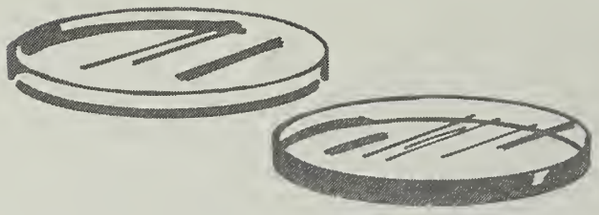
Malathion and diazinon will be tested in capsules to control corn rootworms, grasshoppers, alfalfa weevils, cotton bollworms, and European corn borers. In addition, a capsuled polyhedrosis virus that attacks cotton bollworms and certain other pests will be tested.

Size of capsules, thickness, and kinds of coatings that regulate the time in which the insecticide is released will be tested. The scientists' goal is a uniform application of insecticides for up to 6 weeks.

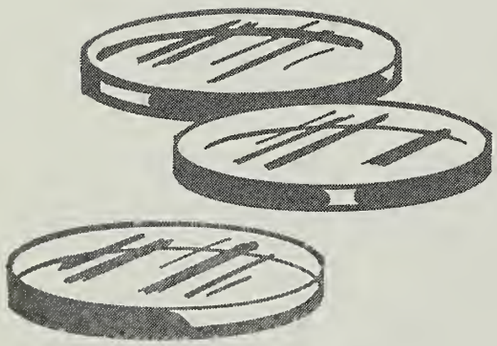
This control method of treating fields would permit use of some of the safest insecticides without the short-term effectiveness that limit the protection they afford a crop. Malathion, for example, protects corn for only a few days, or less if it rains, offsetting its superiority as one of our safest insecticides. Continual release from capsules would greatly extend malathion's protection.

Capsules reduce residue problems, as the insecticide is not applied to the entire plant. Contact by handlers would be virtually eliminated, and encapsulation would minimize problems with both drift and uniformity of application.■





MAREK'S DISEASE VIRUS *GROWN in Lab*



FOR THE FIRST TIME, the virus that causes acute avian leukosis, or Marek's disease, has been grown in the laboratory and examined under the electron microscope.

In recent years, Marek's disease has cost poultrymen millions of dollars in losses of young chickens. Although this disease produces some of the same symptoms as lymphoid leukosis, there has been increasing evidence that the two are separate diseases; the identification of a causative virus of Marek's disease confirms this.

Marek's disease is an acute infection that produces high mortality in a short time. Lymphoid leukosis, however, is a chronic form that strikes older birds and can linger on for months without killing. While Marek's disease affects the nervous system, skin, muscle, and viscera, lymphoid leukosis usually causes the greatest damage in the viscera.

Until recently an outstanding difference between the two agents was that the Marek's disease agent would not grow in a laboratory culture of chick embryo cells. Laboratory cultures, however, are a prerequisite for systematic study of a disease agent, and scientists at the ARS Regional Poultry Research Laboratory at East Lansing, Mich., started an intensive effort 2 years ago to adapt a laboratory culture to the needs of the Marek's disease agent.

Success finally came when ARS microbiologist J. J. Solomon and his coworkers seeded blood from infected chickens on duck embryo cells instead of chick cells. Scientists at the Houghton Poultry Research Station, Houghton, England, announced their simultaneous and independent success with laboratory cultures of Marek's disease virus using chick kidney cells.

Both groups of researchers found that the cell cultures developed colonies of altered cells—evidence that the disease agent was present. Chickens injected with infected cells came down with Marek's disease; those injected with uninfected cells did not.

When ARS microbiologist Keyvan Nazerian examined a culture of infected cells under an electron microscope, he found particles that looked like herpes virus. The herpes group of viruses is unrelated to the virus group involved in lymphoid leukosis. The herpes virus group infects the nucleus of cells, and under experimental conditions have not been infectious outside of cells, probably because the viruses lack an outer coat. This finding may explain why scientists have been unable to transmit the Marek's disease agent from one bird to another without transmitting whole cells from an infected bird to an uninfected bird.

By contrast, lymphoid leukosis viruses infect cell areas outside the nucleus, and they can be isolated outside of the cells they infect.■

...are genetic transfers possible?

CAN GENETIC MATERIAL be passed passed between animals, so that a line of white chickens, for example, would turn gray when injected with blood from gray guinea fowl?

If man could develop such a technique to transfer genetic material between species, he could drastically redesign farm animals to suit his needs. A method such as blood transfusion would overcome the barrier that usually prevents genetic transfer through conventional breeding.

But despite apparent success with color transfer between guinea fowl and chickens in Europe, trials conducted by ARS geneticist P. C. Lowe at the North Central Regional Poultry Breeding Laboratory in Lafayette, Ind., have so far proved disappointing.

Lowe says a scientific theory exists to explain the possibility of color transfer by injection or otherwise. Genetic information—possibly DNA—may be passed from the donor to the recipient, so that donated "information" is passed on to the offspring along with the parent's own genes.

Such genetic transference, Lowe emphasizes, does not change the traits of the parents—just those of the offspring. Therefore, genetic transfer differs from inheritance of acquired characteristics, a discredited theory which held that repeated physical changes inflicted on the parents would affect the offspring. For example, some geneticists once thought that by cutting the tails of a line of dogs for several generations, the offspring would eventually have naturally shorter tails.

One type of color transfer that has had repeated success in the United States has been done with fruit flies—not chickens. Scientists at the University of Wisconsin showed that the body color of young flies was altered from that of their parents by soaking the eggs from which the young hatched in genetic extract from a different line of flies.

As far as color transfer in chickens is concerned, ARS scientists working in Lafayette, Ind., in cooperation with Purdue University, have been testing various techniques—so far unsuccessfully—for 5 years. They followed the Swiss technique carefully in their latest trial, including the use of a special Swiss laboratory strain of White Leghorns, reportedly susceptible to color modification by blood transfusion.

Transfusions from gray guinea fowl, starting when the recipients were 10 days old, continued every 5 days. By the time they were 8 months old, both hens and roosters had been injected with 7 fluid ounces of blood.

The scientists examined 465 progeny from injected birds for 8 weeks after hatching and compared their feather color with that of chicks from Swiss-White Leghorns that had not been injected.

Results showed that the feather color—and every other physical feature—of the two groups was not noticeably different.■

Lowe draws blood from a guinea fowl while J. S. Shatava restrains the bird. T. B. Kinney holds the White Leghorn to be injected (PN-1551).

ARS Technician C. E. Timmer applies floating granules to mats of alligatorweed on this 22-foot deep body of water (PN–1552).

Clear area shows effectiveness of floating granule technique. The photograph was taken 1 year after treatment (PN–1553).

Granules shown here are of the light volcanic glass called perlite used to keep herbicide on the water surface (PN–1554).

FLOATING HERBICIDES WORK BETTER

CAST YOUR HERBICIDE upon the waters, say ARS scientists, and if it floats, you'll get better aquatic weed control.

L. W. Weldon and R. D. Blackburn, in tests conducted in Florida, South Carolina, Georgia, and Louisiana, have found that floating a herbicide on the surface of ponds and waterways is the most effective single treatment for the control of alligatorweed and duckweed. And this treatment promises to be deadly to other aquatic weeds, because most of these weeds float on the surface of ponds and waterways.

Duckweed clogs small ponds; alligatorweed clogs navigable waterways, prevents waterflow, and generally interferes with good utilization of waterways.

In the tests, the scientists experimented with many different materials as carriers on which to float the herbicide, including corn cobs and walnut shells. They discovered, however, that the most effective floating material was perlite, a light volcanic glass. Perlite granules are commonly used as a medium for rooting cuttings.

Weldon says the herbicide-saturated perlite can be spread over the surface of the water by a blower or by hand. His tests show that after two or three applications of paraquat herbicide at 6 pounds per acre, duckweed and alligatorweed are effectively controlled. Weldon calls the method "the floating granule technique."

Paraquat, the herbicide used to develop the floating granule technique, has not been registered by the Department as yet for aquatic weed control.

Some of the tests from which the floating granule technique was developed were conducted in cooperation with the U.S. Army Corps of Engineers and a chemical company.■

HERBICIDE CUTS WATER LOSS

TREATING WATER HYACINTH with 2,4-D not only kills this Southern aquatic weed, but in turn, drastically cuts loss of surface water.

Millions of gallons of water are lost in tropical and subtropical parts of the world by a process called evapotranspiration, a combination of evaporation and transpiration. Transpiration is simply a modified evaporation, the loss of water from living tissue.

Tests by ARS scientists show that a lush growth of water hyacinth can increase evapotranspiration almost four times that of simple evaporation. Through this evapotranspiration, large bodies of water could lose more water than is actually received through rainfall and surface runoff.

In the experiment, ARS technician L. W. Weldon and agronomist C. E. Timmer at Ft. Lauderdale, Fla., used six growth pools, each 3 feet wide, 2 feet high, and 9 feet long. Water hyacinths were planted in four of the pools, while two of the pools were maintained without water hyacinths as a measure of straight evaporation. In the four pools containing water hyacinths, the plants grew into a thick mat about 30 inches tall. The water level of the pools was measured and adjusted weekly.

Besides determining the rate of evapotranspiration as compared to straight evaporation, the scientists were able to correlate the loss to solar irradiation (sun's heat). Now scientists can make accurate predictions about evapotranspiration or evaporation from solar energy data. In case of evapotranspiration, an estimate of water lost per year can be obtained through a knowledge of the estimated number of acres of water hyacinth along with a measurement of solar energy.

The scientists found that after one application of 2,4-D to two of the growth pools, evapotranspiration ceased. The dead weed matter formed a thick layer over the pool by the third week after the application, which also reduced evaporation until it sank to the pool bottom.

The sludge from the dead plants at the bottom of the treated pools was greater than that in the untreated pools (12 and 7 inches respectively). But in the non-herbicide-treated growth pools, the water became turbid and visibility was limited to about 2 feet because of the decaying organic matter.

The normal growing process of water hyacinth has a continuing and pronounced effect on the natural quality of water. Leaves and roots are constantly decaying and being replaced, and coloring materials, such as the tannins and lignins, are leached from the decaying materials. As a result, 1 acre of live water hyacinth can produce water pollution equivalent to the sewage of 40 people.

The herbicide 2,4-D is registered by the Department of Agriculture for use on lakes, ponds, and swampy areas where the water is not used for irrigation, stock, or drinking purposes. When a dense mat of vegetation covers a substantial portion of the water, only part of the area should be treated at one time. Excessive decaying material may result in low oxygen content in the water and result in fish kills.■

Khapra bettle larvae feed on a wide variety of stored products but prefer cereal grains, including corn (BN–2084).

Foreign Scientists Help U.S. Fight Khapra Beetle

THE KHAPRA BEETLE has been eradicated each time it has entered this country, but only at the expense of millions of dollars.

It is still such a formidable threat to stored grains and other food materials, however, that State and Federal quarantine authorities have adopted stringent measures to prevent further outbreaks. These restrictions include prohibiting U.S.D.A. scientists from keeping laboratory cultures for study.

Public Law 480 research grants to India and Israel, however, are helping to provide the detailed information about the khapra beetle that may lead to improved control. Public Law 480 grants are made from local currencies paid by countries that buy U.S. farm products. This money cannot be converted into dollars for use in the United States.

Indian scientists at the Maharaja Sayajirao University of Baroda are conducting research to determine the relationship between fat metabolism in the khapra beetle and diapause, a dormancy phase of its life cycle. This study may provide data leading to breaking the diapause to control the pest. When the larvae are in that quiet state, they can withstand adverse food and climatic conditions for long periods and are more difficult to detect and considerably more resistant to insecticide treatments.

The Israeli scientists at the Hebrew University in Jerusalem explored a number of subjects relating to the khapra beetle, and several significant findings have been singled out for further study.

Olfactory experiments, for example, have led Israeli scientists to suspect that the khapra beetle is one of the few species that secrete a larvae-for-larvae attractant. Larval attractants within the same species are very rare. But if a khapra beetle attractant could be verified, isolated, and synthesized, it could have value as bait for survey and detection purposes.

In studies on the effect of larval excrement in the food media, some fecal element was found to induce diapause. Israeli scientists are now interested in isolating the substance responsible and finding a way to neutralize it to prevent diapause.

Also significant were nutrition studies of vegetable-versus-meat diets in which scientists compared the effects of a wheat diet and a cannibal diet of minced khapra beetle larvae. Larvae fed on their own kind developed more slowly than those fed on wheat. However, females grown on a pure wheat diet averaged only 28.3 eggs a day against an average of 66 eggs per day laid by females grown on a diet of minced larvae.

Other tests indicated a definite relationship between grain molds and the beetle. Both beetles and larvae may be carriers of fungi, and the resulting

mold growth in stored grains benefits the beetle by raising the temperature.

Puzzling contradictions in the physiological activity of the khapra beetle will also require further study. For example:

- The insect spends most of its life in darkness or semidarkness and presumably would not respond to any kind of light. However, Israeli experiments showed that larvae are attracted more by some light waves and intensities than by others.
- Humidity reaction tests indicated the khapra beetle is repelled by high relative humidity. Yet it is a known fact that certain food environments that generate high humidity are beneficial to larval development.■

An Israeli technician examines khapra eggs laid in vessels designed to avoid crushing of eggs by adult beetles (PN–1555).

AGAVE PLANT,

...EFFICIENT WATER USER

MOST PLANTS open their pores in the daytime to permit passage of water and close them at night; the nonconformist agave plant does just the opposite.

As a result, the agave uses far less water than most plants, and it uses its water more efficiently, W. L. Ehrler, plant physiologist at the U.S. Water Conservation Laboratory in Phoenix, Ariz., has stated.

The agave, a distant relative of the pineapple, has long, fleshy, spiny leaves radiating from a central stem. It grows readily in the desert, usually achieving a height of about 3 feet.

Conceivably the plant could be ground up and made palatable for livestock, Ehrler says, although he admits that at present water is not scarce enough to warrant this measure. Ehrler's chief interest in the agave is finding out what causes the plant's contrary reaction to light—and whether a similar reaction can be induced in other plants.

Under bright sunlight, ordinary plants evaporate large volumes of water through their open pores, or stomata. Some of this water is used to cool the plants.

By clamping shut its stomata, the agave avoids this water loss, but without the cooling effect of the evaporating water, its temperature rises to a level that would kill most plants.

In tests comparing corn with agave, Ehrler found that the leaves of the agave plant were as much as 15° F. warmer than air temperature. The corn leaves maintained a temperature about equal to the temperature of the air, due in part to the evaporative cooling from open stomata.

During the 65 days of experiment, the agave plant gained 34 grams in dry weight. The corn plant grew twice as much but used four times as much water. From the standpoint of water conservation, therefore, the agave is twice as efficient as corn.

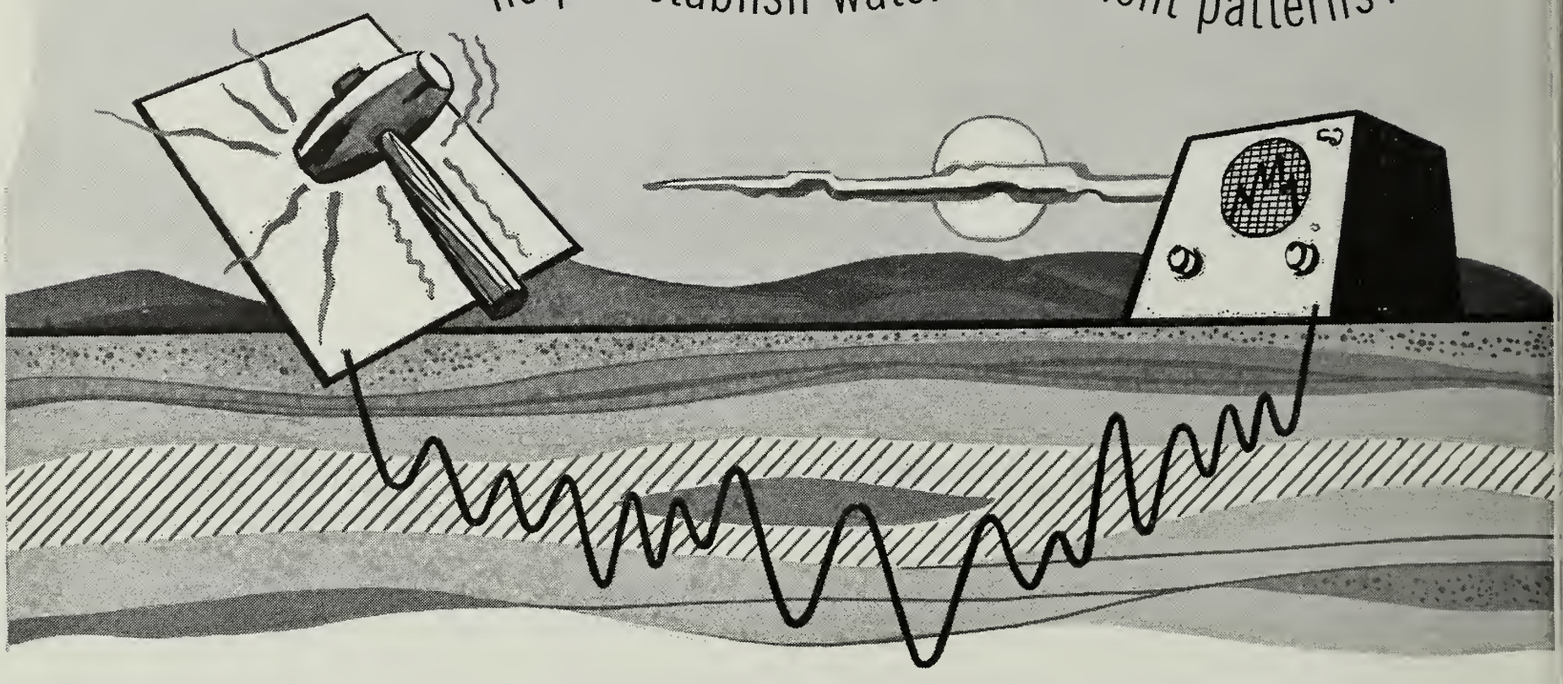
"And corn is a relatively efficient user of water," Ehrler pointed out. "Alfalfa, for example, uses water at a ratio of 1,000 to 1 for each gram of dry matter synthesized," he said.

By opening its stomata at night, the agave probably takes advantage of the greater amount of CO_2 available at night, when other plants aren't using it.

One of the reasons the agave plant is so thrifty with water may be the number of stomata in its leaves. Most plants have at least 50,000 stomata per square inch. Agaves have only about 10,000 per square inch. However, it's what the plant does with its stomata that gives it its peculiar evaporation-resistant quality—and makes it a subject of interest to water conservationists.■

SEISMOLOGY

helps establish water movement patterns . . .



A sledge hammer striking a steel plate produces vibrations that register on seismic-refraction unit.

ARS RESEARCHERS are using seismology—the science of registering earthquake shocks—to cut time and costs in determining water movement on a 90-square-mile Idaho watershed.

In much the same way a seismograph records an earthquake, a device called a seismic-refraction unit registers tell-tale vibrations that reveal soil depth, bedrock configuration, and other subsurface characteristics. Such data are essential to the understanding of water movement necessary for developing systems that use available water most efficiently.

ARS geologist G. R. Stephenson and engineering technician J. F. Zuzel found the unit invaluable in selecting sites for building water-measuring structures, called weirs, in the watershed creeks. Weirs can be built only where foundations are suitable.

With the unit, Stephenson and Zuzel can explore a proposed foundation site in 1 day. Allowing another day for surveying and 2 days for calculation and correlation, they can construct a complete subsurface picture of most proposed sites within a week—compared with the week it took for drilling alone when the earlier method of rotary core drilling was exclusively used.

Seismic exploration is not only faster but also requires 70 percent fewer holes, and the subsurface picture it provides is much more complete.

In addition, the seismic unit has also helped the researchers determine the amount of water that goes into and out of underground reservoirs, an evaluation that depends on establishing the reservoirs' boundary conditions.

The seismic unit is a one-channel, transistorized instrument, 7 by 7 by 11 inches; it weighs 12 pounds. The unit operates with dual geophones—or sensors—and records sound echos to one ten-thousandth of a second.

The study is being conducted on the Reynolds Creek Experimental Watershed in southwest Idaho in cooperation with the Idaho Agricultural Experiment Station.

The researchers produce the vibrations, or waves, that the unit registers by striking a steel plate with an 8-pound hammer. The hammer is connected to the unit by an electric cable. A shock switch mounted on the hammer handle directs a start pulse to the unit.

Other operators have used different energy sources—such as pneumatic hammers, electric blasting caps, and firecrackers—but Stephenson and Zuzel found the sledge hammer more satisfactory.■

RAIN TRAPS FOR WILDLIFE AND RECREATION

A RAIN TRAP DEVELOPED by ARS scientists to catch water for livestock is being tested as a dual-purpose unit to protect against forest fires and to provide water for wildlife.

The trap, consisting of a 20- by 20-foot nylon-reinforced butyl mat and a 1,500-gallon bag, was installed in Coconino National Forest in Arizona by members of the U.S. Water Conservation Laboratory in Phoenix.

The mat is laid on a slope, with one corner lower than the others. Rain and snowmelt collected by the mat are channeled into a pipe connected to the bag. From the bag, the water flows to a watering trough; a float valve reuglates the flow of water from bag to trough. Deer, elk, wild turkey, and songbirds have been observed drinking from the trough.

A 100-foot length of pipe separates the watering trough from the rest of the trap, so that wildlife will not be frightened away by the unfamiliar sight of the bag and mat.

Firefighters can siphon off water from the bag through a T-valve installed in the pipe between the bag and the trough. Such emergency water supplies will prove invaluable for containing and controlling small fires, area forest rangers believe; other water sources are as much as an hour's drive from the forest over very rough roads.

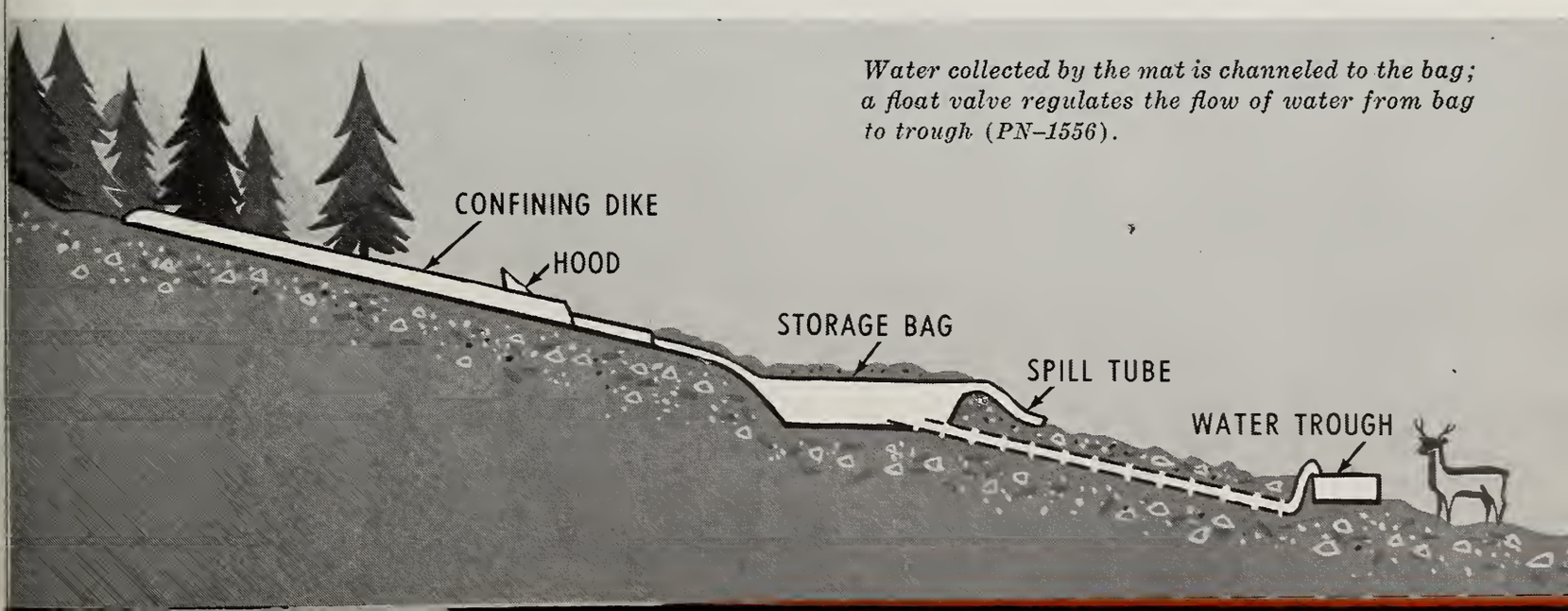
The rain trap, which cost about $400 to install, is similar to one in wide use by farmers and ranchers in water-short areas. It allows stockmen to graze livestock on land lacking a natural source of drinking water. Designed by ARS Scientist O. W. Lauritizen, it is now available commercially in capacities of up to 50,000 gallons.

L. E. Myers and G. W. Frasier, of the U.S. Water Conservation Laboratory, have developed a number of lower cost precipitation catchments for agriculture and foresee many other uses for the devices.

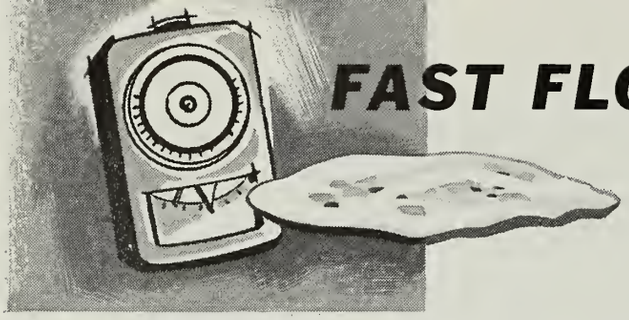
Myers and Frasier said that in addition to collecting water for wildlife, catchments can be used to provide water for fishponds or for drinking by human visitors at many desirable recreational sites that presently have no water supply.

Catchments can be hidden from view or landscaped so that there is no damage to scenery.

The experiments with rain traps for wildlife, recreation, and livestock are being carried out in cooperation with the Forest Service and the U.S. Bureau of Indian Affairs.■



Water collected by the mat is channeled to the bag; a float valve regulates the flow of water from bag to trough (PN–1556).



FAST FLOUR QUALITY TEST FOUND

How good a loaf of bread can you make from a sample of wheat?

A new test developed by ARS should answer the question in about 15 minutes, 20 times faster than baking test methods now used. In addition, little training or experience is needed to run the new test, and when a number of samples are being tested simultaneously, the time per sample is cut to 5 minutes.

Research chemist R. M. Johnson at Beltsville, Md., developed the test after finding that the amount of light reflected from a sample of dough was inversely related to breadmaking quality as measured by protein content, sedimentation value (a protein quality test), and loaf volume.

In the new test, one-half ounce of flour made from a wheat sample is mixed with one-sixth ounce of a dye called acid orange 12 and whipped for 15 seconds in an electric blender to produce dough. This dough is placed in a hydraulic press which forms firm disks under 3,000 pounds of pressure per square inch. The disks, slightly larger than a silver dollar, are then placed in an instrument that measures the amount of light the disk reflects.

Meter readings are taken 15 minutes after the disks are prepared because the amount of light reflected by the disks varies according to the length of time the disks have been allowed to dry. The reading correlates closely with other established laboratory tests now used by cereal chemists for evaluating baking quality.

After an hour at room temperature, the disks may be compared by eye with established flour disk standards that represent different bread baking qualities. This visual procedure, almost as accurate as meter readings, could save the investment in light-measuring equipment.

An important advantage of the new test is that the disks can be distributed among grain buyers to provide them with a visible index of the quality of the grain they are evaluating for purchase.

Samples from five States were tested for 3 crop-years. A variety of growing conditions and commercial wheat samples were checked with the new method to see how well they correlated with established testing methods prior to field tests.■

Tempeh: GOOD SOURCE OF PROTEIN

It can't be said of most foods that they are as good a source of protein as casein, the principal protein in milk.

But this can be said about wheat-soybean tempeh, a tasty new food developed by ARS scientists at the Northern Utilization Research Laboratory, Peoria.

Tempeh is a traditional Indonesian food made by fermenting soybeans. In studies aimed at making tempeh a more versatile food to help meet world hunger problems, the ARS scientists have developed simple and uniform processes for making it not only from soybeans but from wheat and rice. Combinations of these grains and soybeans were also used.

Biochemist H. L. Wang, microbiologist C. W. Hesseltine, and others at the Northern Laboratory have cooperated in the studies (AGR. RES., August 1966, p. 8). In the most recent work, Wang and Hesseltine evaluated the nutritional value of some of the new tempehs in feeding tests with rats.

The difference between casein and wheat-soybean tempeh protein was insignificant. Tempehs made from only wheat or soybeans were not as good protein sources.

Although tempeh provides fewer calories than dried whole milk, it is a good source of energy. Dried tempeh contains less than half as much fat as dried whole milk but about 25 percent more carbohydrate and protein.

Wheat-soybean tempeh is promising as a staple food in countries where animal protein is scarce. It is an excellent source of protein, plus:

- It is made from two of the world's most plentiful food crops—wheat and soybeans.
- Wheat and soybeans are relatively easy to transport and store.
- Tempeh can be made in the home.
- Tempehs can be prepared in a variety of ways—deep-fried, baked, or in soups.■

Booster Shots for Stock Ponds

Stock ponds that have been treated with sodium carbonate to prevent seepage can be kept leakproof with periodic "booster shots" of the chemical.

Three years ago, ARS soil scientists at the U.S. Water Conservation Laboratory in Phoenix, Ariz., disked sodium carbonate into dry pond bottoms. Sodium ions bonded to the clay particles in the soil, causing the soil to swell and creating an almost impermeable seal (AGR., RES., December 1965, p. 13).

In time, some of the sodium carbonate leached out of the soil and ponds began to lose water.

In recent experiments, soil scientist R. J. Reginato and chemist F. S. Nakayama broadcast handfuls of sodium carbonate into the water of treated ponds that were again beginning to show signs of seepage. The treatment restored a nearly impermeable seal to the soil.

Once ponds receive the initial treatment of sodium carbonate, they can be maintained at a high degree of impermeability with very little effort or expense to the farmer.

Reginato and Nakayama tested both pond water and the soil at pond bottom to determine how much sodium carbonate to put in a given pond. They are working on a simplified formula that would permit pond owners to make this calculation themselves. Sodium carbonate is not harmful, but too much of it could make the water so alkaline that cattle would refuse to drink it.

The montmorillonite clay of the region is grainy and relatively porous because positive-charged calcium ions are attached to the clay particles in the soil. But when a sodium salt—such as sodium carbonate—is mixed in the soil, the calcium ions become detached and are replaced by sodium ions. The sodium ions cause the clay particles to swell when wet, break apart, and fill the pores in the soil. This condition sometimes occurs in fields, causing the "slick spots" that hinder farm operations and plant growth; however, it makes the ideal pond bottom.

Southwestern stock ponds merit special attention, Reginato pointed out. Many of them go dry in late summer, forcing farmers to pay up to $10 per 1,000 gallons to have water hauled to their livestock, he said.

High Vacuum May Mean Trouble

An excessively high vacuum in a milking machine may contribute to udder trouble.

The excessive vacuum extends into the teat sinus (milk reservoir) and the resultant stress on udder tissues may increase the incidence of udder infection or activate a dormant infection, possibly causing flareup of mastitis.

ARS veterinarians J. S. McDonald and D. A. Witzel studied milking machine vacuums ranging from 10 to 20 inches of mercury. Most manufacturers recommend that dairymen operate their machines between 12 and 15 inches of mercury.

A machine vacuum up to 16 inches, the researchers found, did not raise the vacuum in the teat sinus. As the machine vacuum increased to 20 inches, however, the vacuum extended more fully into the teat sinus, perhaps because the higher vacuum at the teat end dilated the teat canal.

Bleach Disinfects Tools

Common household bleach—sodium hypochlorite—may take the place of cyanide and mercury compounds as a disinfectant for pruning tools in fire blight control.

ARS researchers found that dipping tools after each use in a 1-part-bleach-to-9-part-water solution for 2 seconds prevented transfer of the fire blight bacteria *Erwinia amylovora* to tender, susceptible Jonathan apple twigs.

In 1880 fire blight was discovered to be caused by bacteria. Not until 1898, however, did farmers recognize the importance of treating pruning tools with a germicide to prevent spreading the disease. Since that time, many disinfectants have been used; the current standard recommendation is either 1 ounce bichloride of mercury in 8 gallons of water or a combination of 1 ounce mercuric cyanide and 1 ounce of bichloride of mercury in 4 gallons of water.

Apple and pear growers have found solutions containing mercury compounds to be very effective germicides for cleaning pruning tools used in the control of fire blight. However, mercury compounds are extremely poisonous to man and animals and require extreme caution in their use.

Household bleach as a disinfectant for pruning tools has only one drawback: it will corrode tool metals after prolonged use. ARS plant pathologist H. L. Keil and T. van der Zwet, Beltsville, Md., who tested the bleach as a disinfectant, recommend that at the end of each day the pruning tools be rinsed in running tap water, then dried and all the surfaces oiled.

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AGRISEARCH NOTES

Full Freezer Means Economy

Home food freezers are not novelties—more than one-fourth of U.S. housekeeping households have them. While many owners use their freezers efficiently, some could benefit from improving their management practices.

A survey by ARS food economists of 482 farm and urban households in Indiana revealed that improvement could come from making sure the freezer is cold enough to maintain frozen food quality (about 30 percent of farm freezers and 40 percent of those in city homes registered higher than 0° F); keeping accurate inventory records; and dating food packages.

One finding of the survey was that more farm freezers were filled or almost filled to capacity. About one-third of those in both types of households were half full while 20 percent of the farm freezers and 32 percent of the city freezers were only about one-fourth full. Economists point out that the expense of running a sparsely filled freezer can be higher per pound of frozen food when one considers that it costs almost as much to operate an empty freezer as a full one.

A large number of both urban and farm homemakers grouped similiar foods together in the freezer so they could tell when the stock was low, but only about 10 percent of the urban and 24 percent of the farm homemakers kept a running record of food on hand. About 50 percent of the city homemakers and 60 percent of farm housewives said the packages were usually dated, either by themselves or by someone else before the product reached them.

7-High Saves Money

By stacking watermelons higher, costs of shipping them by rail from Southeastern producers to Northeastern markets could be reduced by about 25 percent or $200,000 annually.

Two researchers, industry economist P. L. Breakiron and marketing specialist W. R. Black, found that watermelons could be stacked in seven layers instead of the customary five.

They also compared two cushioning materials—straw and polystyrene foam. Polystyrene proved superior because the foam material allowed for more air circulation from floor vents and was cleaner and less irritating for workers to handle.

New Use for Penny Bank

A penny bank may save ARS researchers thousands of dollars in equipment costs.

S. A. Bowers, soil scientist at the Snake River Conservation Research Center in Twin Falls, Idaho, used a 4-inch world globe bank as the principal component of his portable reflectometer, a device for measuring reflection from plant leaves.

Such data are necessary to determine how plants use radiant energy. Several available instruments will do the job, but most are both expensive and cumbersome. Bower's invention should prove ideal for spot checks of leaf reflection under field conditions.

It consists of the globe, which is coated inside with magnesium oxide; a series of lenses; a shutter; an iris diaphragm; a flashlight bulb; and a series of interchangeable filters for wavelength selection.

Light from the bulb passes through filter and lenses, strikes the leaf, bounces back into the globe, then reflects back and forth from the magnesium oxide surface. The resulting uniform light density is recorded by a sensing device.

Materials for the reflectometer, including filters, cost $450, Bowers said. A full-size laboratory model sells for $2,000 and up.

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.